AMENDMENTS TO THE CLAIMS

This listing of claims will replace all prior versions and listings of claims in the application:

LISTING OF CLAIMS:

1-2. (Canceled).

3. (Currently Amended) A portable radio system comprising:

an internal oscillator; and

an automatic frequency control for detecting a frequency shift of said internal oscillator with reference to a received wave transmitted from a base station and adjusting a frequency of said internal oscillator by feeding back said frequency shift to said internal oscillator,

wherein coordinate rotation digital computation (CORDIC) is employed for calculation of arctangent in said automatic frequency control; and

~~A portable radio system as set forth in claim 1,~~ wherein, upon performing calculation~~,~~ ~~upon performing calculation~~ said detecting of said frequency shift~~,~~ comprises deriving parameters CORDICi and CORDICq ~~are derived~~ by ~~using a calculation of~~ said coordinate rotation digital computation ~~by replacing the~~, where

a signal whose phase is to be calculated ~~the phase~~ is replaced with I and Q components of said signal, and

in calculation of said coordinate rotation digital computation, when a parameter for outputting a final angle by adding angles per taps is set as phase, ~~in former stage of said coordinate rotation digital computation,~~ a process expressed by:

when CORDICi < 0.0 and CORDICq > 0.0

CORDICi = CORDICq

CORDICq = CORDICi * -1.0

phase = $\pi/2$

when CORDICi < 0.0 and CORDICq < 0.0,

CORDICi = CORDICq * -1.0

CORDICq = CORDICi

phase = $-(\pi/2)$

is performed.

4. (Currently Amended): <u>A portable radio system comprising:</u>

<u>an internal oscillator; and</u>

<u>an automatic frequency control for detecting a frequency shift of said internal oscillator with reference to a received wave transmitted from a base station and adjusting a frequency of said internal oscillator by feeding back said frequency shift to said internal oscillator,</u>

<u>wherein coordinate rotation digital computation (CORDIC) is employed for calculation of arctangent in said automatic frequency control; and</u>

~~A portable radio system as set forth in claim 1,~~ wherein~~, upon performing calculation~~ said detecting of said frequency shift~~,~~ comprises deriving parameters CORDICi and CORDICq ~~are derived~~ by~~ using a calculation of~~ said coordinate rotation digital computation~~ by replacing the~~, where

a signal whose phase is to be calculated ~~the phase~~ is replaced with I and Q components of said signal, and in calculation of said coordinate rotation digital computation, when a parameter for outputting a final angle by adding angles per taps is set as phase~~, in former stage of said coordinate rotation digital computation~~, a process expressed by:

when CORDICi < 0.0 and CORDICq > 0.0

CORDICi = CORDICi * -1

CORDICq = CORDICq * -1

phase = π

when CORDICi < 0.0 and CORDICq < 0.0,

CORDICi = CORDICi * -1

CORDICq = CORDICq * -1

phase = - π

is performed.

5-7. (Canceled).

8. (Currently Amended) A portable radio system employing an automatic frequency control for detecting a frequency shift of an internal oscillator of a portable radio equipment with reference to a received wave transmitted from a base station and adjusting the frequency of said internal oscillator by feeding back said frequency shift to said internal oscillator, wherein said portable radio equipment comprises;

calculating means for calculating a phase difference of two symbols taken from a known data modulated by said base station on the basis of a timing generated by said internal oscillator;

frequency shift calculating means for calculating a frequency shift of said internal oscillator by dividing said phase difference derived by said calculating means by an interval of said two symbols; and

control means for widening said interval when said phase difference derived by said calculating means is smaller than a predetermined set value, and for narrowing said interval when said phase difference is greater than said set value;

wherein said two symbols are the same phase when a frequency of said internal oscillator is correct, and

said calculating means derives a phase difference of said two symbols by multiplying one of said two symbols by a complex conjugate of another symbol;

wherein upon calculation of arctangent by employing coordinate rotation digital computation (CORDIC), said frequency shift calculating means performs calculation within a range of $\pm\pi$; and

~~A portable radio system as set forth in claim 7,~~ wherein~~, upon performing calculation~~ said detecting of said frequency shift~~,~~ comprises deriving parameters CORDICi and CORDICq ~~are derived~~ by ~~using a calculation of~~ said coordinate rotation digital computation ~~by replacing the~~, where

a signal whose phase is to be calculated ~~the phase~~ is replaced with I and Q components of said signal, and

in calculation of said coordinate rotation digital computation, when a parameter for outputting a final angle by adding angles per taps is set as phase~~, in former stage of said coordinate rotation digital computation~~, a process expressed by:

when CORDICi < 0.0 and CORDICq > 0.0

CORDICi = CORDICq

CORDICq = CORDICi * -1.0

phase = $\pi/2$

when CORDICi < 0.0 and CORDICq < 0.0,

CORDICi = CORDICq * -1.0

CORDICq = CORDICi

phase = -($\pi/2$)

is performed.

9. (Currently Amended) A portable radio system employing an automatic frequency control for detecting a frequency shift of an internal oscillator of a portable radio

equipment with reference to a received wave transmitted from a base station and adjusting the frequency of said internal oscillator by feeding back said frequency shift to said internal oscillator, wherein said portable radio equipment comprises;

calculating means for calculating a phase difference of two symbols taken from a known data modulated by said base station on the basis of a timing generated by said internal oscillator;

frequency shift calculating means for calculating a frequency shift of said internal oscillator by dividing said phase difference derived by said calculating means by an interval of said two symbols; and

control means for widening said interval when said phase difference derived by said calculating means is smaller than a predetermined set value, and for narrowing said interval when said phase difference is greater than said set value;

wherein said two symbols are the same phase when a frequency of said internal oscillator is correct, and

said calculating means derives a phase difference of said two symbols by multiplying one of said two symbols by a complex conjugate of another symbol;

wherein upon calculation of arctangent by employing coordinate rotation digital computation (CORDIC), said frequency shift calculating means performs calculation within a range of $\pm\pi$; and

~~A portable radio system as set forth in claim 7,~~ wherein~~, upon performing calculation~~ said detecting of said frequency shift~~,~~ comprises deriving parameters CORDICi and CORDICq

~~are derived~~ by ~~using a calculation of~~ said coordinate rotation digital computation ~~by replacing the~~, where

a signal whose phase is to be calculated ~~the phase~~ is replaced with I and Q components of said signal, and

in calculation of said coordinate rotation digital computation, when a parameter for outputting a final angle by adding angles per taps is set as phase~~, in former stage of said coordinate rotation digital computation~~, a process expressed by:

when CORDICi < 0.0 and CORDICq > 0.0

CORDICi = CORDICi * -1

CORDICq = CORDICq * -1

phase = π

when CORDICi < 0.0 and CORDICq < 0.0,

CORDICi = CORDICi * -1

CORDICq = CORDICq * -1

phase = - π

is performed.

10. (Currently Amended) A portable radio system employing an automatic frequency control for detecting a frequency shift of an internal oscillator of a portable radio equipment with reference to a received wave transmitted from a base station and adjusting the

frequency of said internal oscillator by feeding back said frequency shift to said internal oscillator, wherein said portable radio equipment comprises;

calculating means for calculating a phase difference of two symbols taken from a known data modulated by said base station on the basis of a timing generated by said internal oscillator;

frequency shift calculating means for calculating a frequency shift of said internal oscillator by dividing said phase difference derived by said calculating means by an interval of said two symbols; and

control means for widening said interval when said phase difference derived by said calculating means is smaller than a predetermined set value, and for narrowing said interval when said phase difference is greater than said set value; and

~~A portable radio system as set forth in claim 5,~~ wherein said control means sets said interval at a predetermined minimum value when out of synchronization is detected ~~at least from~~ due to one of a failure ~~of decoding~~ to decode or ~~non-detection of~~ to detect a pilot and ~~not reaching~~ a failure of power to reach a predetermined level.

11-13. (Canceled).

14. (Currently Amended) A portable radio system employing an automatic frequency control for detecting a frequency shift of an internal oscillator of a portable radio equipment with reference to a received wave transmitted from a base station and adjusting the

frequency of said internal oscillator by feeding back said frequency shift to said internal oscillator, wherein said portable radio equipment comprises:

calculating means for calculating a phase difference of two symbols taken from a known data modulated by said base station on the basis of a timing generated by said internal oscillator;

frequency shift calculating means for calculating a frequency shift of said internal oscillator by dividing said phase difference derived by said calculating means by an interval of said two symbols; and

control means for widening said interval when a value of said frequency shift derived by said frequency shift calculating means is smaller than a predetermined value and for narrowing said interval when said value of said frequency shift is greater than said predetermined value;

wherein said two symbols are the same phase when a frequency of said internal oscillator is correct, and

said calculating means derives a phase difference of said two symbols by multiplying one of said two symbols by a complex conjugate of another symbol;

wherein upon calculation of arctangent of coordinate rotation digital computation (CORDIC), said frequency shift calculating means performs calculation within a range of $\pm\pi$; and

~~A portable radio system as set forth in claim 13,~~ wherein~~, upon performing calculation~~ said detecting of said frequency shift~~,~~ comprises deriving parameters CORDICi and CORDICq ~~are derived~~ by ~~using a calculation of~~ said coordinate rotation digital computation ~~by replacing the~~, where

a signal whose phase is to be calculated ~~the phase~~ is replaced with I and Q components of said signal, and

in calculation of said coordinate rotation digital computation, when a parameter for outputting a final angle by adding angles per taps is set as phase~~, in former stage of said coordinate rotation digital computation~~, a process expressed by:

when CORDICi < 0.0 and CORDICq > 0.0

CORDICi = CORDICq

CORDICq = CORDICi * -1.0

phase = $\pi/2$

when CORDICi < 0.0 and CORDICq < 0.0,

CORDICi = CORDICq * -1.0

CORDICq = CORDICi

phase = $-(\pi/2)$

is performed.

15. (Currently Amended) A portable radio system employing an automatic frequency control for detecting a frequency shift of an internal oscillator of a portable radio equipment with reference to a received wave transmitted from a base station and adjusting the frequency of said internal oscillator by feeding back said frequency shift to said internal oscillator, wherein said portable radio equipment comprises:

calculating means for calculating a phase difference of two symbols taken from a known data modulated by said base station on the basis of a timing generated by said internal oscillator;

frequency shift calculating means for calculating a frequency shift of said internal oscillator by dividing said phase difference derived by said calculating means by an interval of said two symbols; and

control means for widening said interval when a value of said frequency shift derived by said frequency shift calculating means is smaller than a predetermined value and for narrowing said interval when said value of said frequency shift is greater than said predetermined value;

wherein said two symbols are the same phase when a frequency of said internal oscillator is correct, and

said calculating means derives a phase difference of said two symbols by multiplying one of said two symbols by a complex conjugate of another symbol;

wherein upon calculation of arctangent of coordinate rotation digital computation (CORDIC), said frequency shift calculating means performs calculation within a range of $\pm \pi$; and

~~A portable radio system as set forth in claim 13,~~ wherein~~, upon performing calculation~~ said detection of said frequency shift~~,~~ comprises deriving parameters CORDICi and CORDICq ~~are derived~~ by ~~using a calculation of~~ said coordinate rotation digital computation ~~by replacing the~~, where

a signal whose phase is to be calculated ~~the phase~~ is replaced with I and Q components of said signal, and

in calculation of said coordinate rotation digital computation, when a parameter for outputting a final angle by adding angles per taps is set as phase~~, in former stage of said coordinate rotation digital computation~~, a process expressed by:

when CORDICi < 0.0 and CORDICq > 0.0

CORDICi = CORDICi * -1

CORDICq = CORDICq * -1

phase = π

when CORDICi < 0.0 and CORDICq < 0.0,

CORDICi = CORDICi * -1

CORDICq = CORDICq * -1

phase = - π

is performed.

16. (Currently Amended) A portable radio system employing an automatic frequency control for detecting a frequency shift of an internal oscillator of a portable radio equipment with reference to a received wave transmitted from a base station and adjusting the frequency of said internal oscillator by feeding back said frequency shift to said internal oscillator, wherein said portable radio equipment comprises:

calculating means for calculating a phase difference of two symbols taken from a known data modulated by said base station on the basis of a timing generated by said internal oscillator;

frequency shift calculating means for calculating a frequency shift of said internal oscillator by dividing said phase difference derived by said calculating means by an interval of said two symbols; and

control means for widening said interval when a value of said frequency shift derived by said frequency shift calculating means is smaller than a predetermined value and for narrowing said interval when said value of said frequency shift is greater than said predetermined value; and

~~A portable radio system as set forth in claim 11,~~ wherein said control means sets said interval at a predetermined minimum value when out of synchronization is detected ~~at least from~~ due to one of a failure ~~of decoding~~ to decode or ~~non-detection of~~ to detect a pilot and ~~not reaching~~ a failure of power to reach a predetermined level.

17-18. (Canceled).

19. (Currently Amended) A portable radio equipment comprising:

an internal oscillator; and

an automatic frequency control for detecting a frequency shift of said internal oscillator with reference to a received wave transmitted from a base station and adjusting a frequency of said internal oscillator by feeding back said frequency shift to said internal oscillator,

wherein coordinate rotation digital computation (CORDIC) is employed for calculation of arctangent in said automatic frequency control; and

~~A portable radio equipment as set forth in claim 17,~~ wherein~~, upon performing calculation~~ said detecting of said frequency shift~~,~~ comprises deriving parameters CORDICi and CORDICq ~~are derived~~ by ~~using a calculation of~~ said coordinate rotation digital computation ~~by replacing the~~, where

a signal whose phase is to be calculated ~~the phase~~ is replaced with I and Q components of said signal, and

in calculation of said coordinate rotation digital computation, when a parameter for outputting a final angle by adding angles per taps is set as phase~~, in former stage of said coordinate rotation digital computation~~, a process expressed by:

when CORDICi < 0.0 and CORDICq > 0.0

CORDICi = CORDICq

CORDICq = CORDICi * -1.0

phase = $\pi/2$

when CORDICi < 0.0 and CORDICq < 0.0,

CORDICi = CORDICq * -1.0

CORDICq = CORDICi

phase = $-(\pi/2)$

is performed.

20. (Currently Amended) A portable radio equipment comprising:

an internal oscillator; and

an automatic frequency control for detecting a frequency shift of said internal oscillator with reference to a received wave transmitted from a base station and adjusting a frequency of said internal oscillator by feeding back said frequency shift to said internal oscillator,

wherein coordinate rotation digital computation (CORDIC) is employed for calculation of arctangent in said automatic frequency control; and

~~A portable radio equipment as set forth in claim 17,~~ wherein~~, upon performing calculation~~ said detecting of said frequency shift~~,~~ comprises deriving parameters CORDICi and CORDICq ~~are derived~~ by ~~using a calculation of~~ said coordinate rotation digital computation ~~by replacing the~~, where

a signal whose phase is to be calculated the phase with I and Q components of said signal, and

in calculation of said coordinate rotation digital computation, when a parameter for outputting a final angle by adding angles per taps is set as phase~~, in former stage of said coordinate rotation digital computation~~, a process expressed by:

when CORDICi < 0.0 and CORDICq > 0.0

CORDICi = CORDICi * -1

CORDICq = CORDICq * -1

phase = π

when CORDICi < 0.0 and CORDICq < 0.0,

CORDICi = CORDICi * -1

CORDICq = CORDICq * -1

phase = - π

is performed.

21-23. (Canceled).

24. (Currently Amended) A portable radio equipment employing an automatic frequency control for detecting a frequency shift of an internal oscillator of own portable radio equipment with reference to a received wave transmitted from a base station and adjusting the frequency of said internal oscillator by feeding back said frequency shift to said internal oscillator, comprising:

calculating means for calculating a phase difference of two symbols taken from a known data modulated by said base station on the basis of a timing generated by said internal oscillator;

frequency shift calculating means for calculating a frequency shift of said internal oscillator by dividing said phase difference derived by said calculating means by an interval of said two symbols; and

control means for widening said interval when said phase difference derived by said calculating means is smaller than a predetermined set value and for narrowing said interval when said phase difference is greater than said set value;

wherein said two symbols are the same phase when a frequency of said internal oscillator is correct, and

said calculating means derives a phase difference of said two symbols by multiplying one of said two symbols by a complex conjugate of another symbol;

wherein upon calculation of arctangent by employing coordinate rotation digital computation, said frequency shift calculating means performs calculation within a range of $\pm \pi$; and

~~A portable radio equipment as set forth in claim 23,~~ wherein~~, upon performing calculation~~ said detecting of said frequency shift~~,~~ comprises deriving parameters CORDICi and CORDICq ~~are derived~~ by ~~using a calculation of~~ said coordinate rotation digital computation ~~by replacing the~~, where

a signal whose phase is to be calculated ~~the phase~~ is replaced with I and Q components of said signal, and

in calculation of said coordinate rotation digital computation, when a parameter for outputting a final angle by adding angles per taps is set as phase~~, in former stage of said coordinate rotation digital computation~~, a process expressed by:

A frequency error predicting method

when CORDICi < 0.0 and CORDICq > 0.0

CORDICi = CORDICq

CORDICq = CORDICi * -1.0

phase = $\pi/2$

when CORDICi < 0.0 and CORDICq < 0.0,

CORDICi = CORDICq * -1.0

CORDICq = CORDICi

phase = -(π /2)

is performed.

25. (Currently Amended) A portable radio equipment employing an automatic frequency control for detecting a frequency shift of an internal oscillator of own portable radio equipment with reference to a received wave transmitted from a base station and adjusting the frequency of said internal oscillator by feeding back said frequency shift to said internal oscillator, comprising:

calculating means for calculating a phase difference of two symbols taken from a known data modulated by said base station on the basis of a timing generated by said internal oscillator;

frequency shift calculating means for calculating a frequency shift of said internal oscillator by dividing said phase difference derived by said calculating means by an interval of said two symbols; and

control means for widening said interval when said phase difference derived by said calculating means is smaller than a predetermined set value and for narrowing said interval when said phase difference is greater than said set value;

wherein said two symbols are the same phase when a frequency of said internal oscillator is correct, and

said calculating means derives a phase difference of said two symbols by multiplying one of said two symbols by a complex conjugate of another symbol;

wherein upon calculation of arctangent by employing coordinate rotation digital computation, said frequency shift calculating means performs calculation within a range of $\pm\pi$; and

~~A portable radio equipment as set forth in claim 23,~~ wherein~~, upon performing calculation~~ said detecting of said frequency shift~~,~~ comprises deriving parameters CORDICi and CORDICq~~ are derived~~ by~~ using a calculation of~~ said coordinate rotation digital computation~~ by replacing the~~, where

a signal whose phase is to be calculated~~ the phase~~ is replaced with I and Q components of said signal, and

in calculation of said coordinate rotation digital computation, when a parameter for outputting a final angle by adding angles per taps is set as phase~~, in former stage of said coordinate rotation digital computation~~, a process expressed by:

when CORDICi < 0.0 and CORDICq > 0.0

CORDICi = CORDICi * -1

CORDICq = CORDICq * -1

phase = π

when CORDICi < 0.0 and CORDICq < 0.0,

CORDICi = CORDICi * -1

CORDICq = CORDICq * -1

phase = - π

is performed.

26. (Currently Amended) A portable radio equipment employing an automatic frequency control for detecting a frequency shift of an internal oscillator of own portable radio equipment with reference to a received wave transmitted from a base station and adjusting the frequency of said internal oscillator by feeding back said frequency shift to said internal oscillator, comprising:

calculating means for calculating a phase difference of two symbols taken from a known data modulated by said base station on the basis of a timing generated by said internal oscillator;

frequency shift calculating means for calculating a frequency shift of said internal oscillator by dividing said phase difference derived by said calculating means by an interval of said two symbols; and

control means for widening said interval when said phase difference derived by said calculating means is smaller than a predetermined set value and for narrowing said interval when said phase difference is greater than said set value; and

~~A portable radio equipment as set forth in claim 21,~~ wherein said control means sets said interval at a predetermined minimum value when out of synchronization is detected ~~at least from~~ due to one of a failure ~~of decoding of non-detection of~~ to decode or to detect a pilot and ~~not reaching~~ a failure of power to reach a predetermined level.

27-29. (Canceled).

30. (Currently Amended) A portable radio equipment employing an automatic frequency control for detecting a frequency shift of an internal oscillator of own portable radio equipment with reference to a received wave transmitted from a base station and adjusting the frequency of said internal oscillator by feeding back said frequency shift to said internal oscillator, comprising:

calculating means for calculating a phase difference of two symbols taken from a known data modulated by said base station on the basis of a timing generated by said internal oscillator;

frequency shift calculating means for calculating a frequency shift of said internal oscillator by dividing said phase difference derived by said calculating means by an interval of said two symbols; and

control means for widening said interval when a value of said frequency shift derived by said frequency shift calculating means is smaller than a predetermined value and for narrowing said interval when said value of said frequency shift is greater than said predetermined value;

wherein upon calculation of arctangent by employing coordinate rotation digital computation, said frequency shift calculating means performs calculation within a range of $\pm\pi$; and

~~A portable radio equipment as set forth in claim 29,~~ wherein~~, upon performing calculation~~ said detecting of said frequency shift~~,~~ comprises deriving parameters CORDICi and CORDICq ~~are derived~~ by ~~using a calculation of~~ said coordinate rotation digital computation ~~by replacing the~~, where

a signal whose phase is to be calculated ~~the phase~~ is replaced with I and Q components, and

in calculation of said coordinate rotation digital computation, when a parameter for outputting a final angle by adding angles per taps is set as phase~~, in former stage of said coordinate rotation digital computation~~, a process expressed by:

when CORDICi < 0.0 and CORDICq > 0.0

CORDICi = CORDICq

CORDICq = CORDICi * -1.0

phase = $\pi/2$

when CORDICi < 0.0 and CORDICq < 0.0,

CORDICi = CORDICq * -1.0

CORDICq = CORDICi

phase = -($\pi/2$)

is performed.

31. (Currently Amended) A portable radio equipment employing an automatic frequency control for detecting a frequency shift of an internal oscillator of own portable radio equipment with reference to a received wave transmitted from a base station and adjusting the frequency of said internal oscillator by feeding back said frequency shift to said internal oscillator, comprising:

calculating means for calculating a phase difference of two symbols taken from a known data modulated by said base station on the basis of a timing generated by said internal oscillator;

frequency shift calculating means for calculating a frequency shift of said internal oscillator by dividing said phase difference derived by said calculating means by an interval of said two symbols; and

control means for widening said interval when a value of said frequency shift derived by said frequency shift calculating means is smaller than a predetermined value and for narrowing said interval when said value of said frequency shift is greater than said predetermined value;

wherein upon calculation of arctangent by employing coordinate rotation digital computation, said frequency shift calculating means performs calculation within a range of $\pm\pi$; and

~~A portable radio equipment as set forth in claim 29,~~ wherein~~, upon performing calculation~~ said detecting of said frequency shift~~,~~ comprises deriving parameters CORDICi and CORDICq ~~are derived~~ by ~~using a calculation of~~ said coordinate rotation digital computation ~~by replacing the~~, where

a signal whose phase is to be calculated ~~the phase~~ is replace with I and Q components of said signal, and

in calculation of said coordinate rotation digital computation, when a parameter for outputting a final angle by adding angles per taps is set as phase~~, in former stage of said coordinate rotation digital computation~~, a process expressed by:

when CORDICi < 0.0 and CORDICq > 0.0

CORDICi = CORDICi * -1

CORDICq = CORDICq * -1

phase = π

when CORDICi < 0.0 and CORDICq < 0.0,

CORDICi = CORDICi * -1

CORDICq = CORDICq * -1

phase = - π

is performed.

32. (Currently Amended) A portable radio equipment employing an automatic frequency control for detecting a frequency shift of an internal oscillator of own portable radio equipment with reference to a received wave transmitted from a base station and adjusting the frequency of said internal oscillator by feeding back said frequency shift to said internal oscillator, comprising:

calculating means for calculating a phase difference of two symbols taken from a known data modulated by said base station on the basis of a timing generated by said internal oscillator;

frequency shift calculating means for calculating a frequency shift of said internal oscillator by dividing said phase difference derived by said calculating means by an interval of said two symbols; and

control means for widening said interval when a value of said frequency shift derived by said frequency shift calculating means is smaller than a predetermined value and for narrowing

said interval when said value of said frequency shift is greater than said predetermined value; and

~~A portable radio equipment as set forth in claim 27,~~ wherein said control means sets said interval at a predetermined minimum value when out of synchronization is detected ~~at least from~~ due to one of a failure ~~of decoding~~ to decode or ~~non-detection of~~ to detect a pilot and ~~not reaching~~ a failure of power to reach a predetermined level.

33-34. (Canceled).

35. (Currently Amended) A frequency error predicting method comprising:

detecting, employing an automatic frequency control, a frequency shift of an internal oscillator of portable radio equipment with reference to a received wave transmitted from a base station; and

adjusting the frequency of said internal oscillator by feeding back said frequency shift to said internal oscillator,

wherein coordinate rotation digital computation (CORDIC) is employed for calculation of arctangent in said automatic frequency control;

wherein, upon calculation of arctangent, calculation is performed within a range of $\pm\pi$; and

~~A frequency error predicting method as set forth in claim 34,~~ wherein~~, upon performing calculation~~ said detecting of said frequency shift~~,~~ comprises deriving parameters CORDICi and

CORDICq~~ are derived~~ by~~ using a calculation of~~ said coordinate rotation digital computation~~ by replacing the~~, where

a signal whose phase is to be calculated~~ the phase~~ is replaced with I and Q components of said signal, and

in calculation of said coordinate rotation digital computation, when a parameter for outputting a final angle by adding angles per taps is set as phase~~, in former stage of said coordinate rotation digital computation~~, a process expressed by:

when CORDICi < 0.0 and CORDICq > 0.0

CORDICi = CORDICq

CORDICq = CORDICi * -1.0

phase = $\pi/2$

when CORDICi < 0.0 and CORDICq < 0.0,

CORDICi = CORDICq * -1.0

CORDICq = CORDICi

phase = $-(\pi/2)$

is performed.

36. (Currently Amended) A frequency error predicting method comprising:

detecting, employing an automatic frequency control, a frequency shift of an internal oscillator of portable radio equipment with reference to a received wave transmitted from a base station; and

adjusting the frequency of said internal oscillator by feeding back said frequency shift to said internal oscillator,

wherein coordinate rotation digital computation (CORDIC) is employed for calculation of arctangent in said automatic frequency control;

wherein, upon calculation of arctangent, calculation is performed within a range of $\pm\pi$; and

~~A frequency error predicting method as set forth in claim 34,~~ wherein~~, upon performing calculation~~ said detecting of said frequency shift~~,~~ comprises deriving parameters CORDICi and CORDICq ~~are derived~~ by ~~using a calculation of~~ said coordinate rotation digital computation ~~by replacing the~~, where

a signal whose phase is to be calculated ~~the phase~~ is replaced with I and Q components of said signal, and

in calculation of said coordinate rotation digital computation, when a parameter for outputting a final angle by adding angles per taps is set as phase~~, in former stage of said coordinate rotation digital computation~~, a process expressed by:

when CORDICi < 0.0 and CORDICq > 0.0

CORDICi = CORDICi * -1

CORDICq = CORDICq * -1

phase = π

when CORDICi < 0.0 and CORDICq < 0.0,

CORDICi = CORDICi * -1

CORDICq = CORDICq * -1

phase = - π

is performed.

37-39. (Canceled).

40. (Currently Amended) A frequency error predicting method employing an automatic frequency control for detecting a frequency shift of an internal oscillator of portable radio equipment with reference to a received wave transmitted from a base station and adjusting the frequency of said internal oscillator by feeding back said frequency shift to said internal oscillator, comprising of steps of:

calculating a phase difference of two symbols taken from a known data modulated by said base station on the basis of a timing generated by said internal oscillator;

calculating a frequency shift of said internal oscillator by dividing said phase difference derived by said calculating step by an interval of said two symbols; and

widening said interval when said phase difference derived by said phase difference calculating step is smaller than a predetermined set value and narrowing said interval when said phase difference is greater than said set value;

wherein upon calculation of arctangent of coordinate rotation digital computation, said frequency shift calculating step performs calculation within a range of $\pm \pi$; and

~~A frequency error predicting method as set forth in claim 39,~~ wherein~~, upon performing calculation of said frequency shift, in~~ said frequency shift calculating step~~,~~ further comprises deriving parameters CORDICi and CORDICq ~~are derived~~ by ~~using a calculation of~~ said coordinate rotation digital computation ~~by replacing the~~, where

a signal whose phase is to be calculated ~~the phase~~ is replaced with I and Q components of said signal, and

in calculation of said coordinate rotation digital computation, when a parameter for outputting a final angle by adding angles per taps is set as phase~~, in former stage of said coordinate rotation digital computation~~, a process expressed by:

when CORDICi < 0.0 and CORDICq > 0.0

CORDICi = CORDICq

CORDICq = CORDICi * -1.0

phase = $\pi/2$

when CORDICi < 0.0 and CORDICq < 0.0,

CORDICi = CORDICq * -1.0

CORDICq = CORDICi

phase = -($\pi/2$)

is performed.

41. (Currently Amended) A frequency error predicting method employing an automatic frequency control for detecting a frequency shift of an internal oscillator of portable

radio equipment with reference to a received wave transmitted from a base station and adjusting the frequency of said internal oscillator by feeding back said frequency shift to said internal oscillator, comprising of steps of:

calculating a phase difference of two symbols taken from a known data modulated by said base station on the basis of a timing generated by said internal oscillator;

calculating a frequency shift of said internal oscillator by dividing said phase difference derived by said calculating step by an interval of said two symbols; and

widening said interval when said phase difference derived by said phase difference calculating step is smaller than a predetermined set value and narrowing said interval when said phase difference is greater than said set value;

wherein upon calculation of arctangent of coordinate rotation digital computation, said frequency shift calculating step performs calculation within a range of $\pm \pi$; and

~~A frequency error predicting method as set forth in claim 39,~~ wherein~~, upon performing calculation of said frequency shift, in~~ said frequency shift calculating step~~,~~ further comprises deriving parameters CORDICi and CORDICq ~~are derived~~ by ~~using a calculation of~~ said coordinate rotation digital computation ~~by replacing the~~, where

a signal whose phase is to be calculated ~~the phase~~ is replaced with I and Q components, and

in calculation of said coordinate rotation digital computation, when a parameter for outputting a final angle by adding angles per taps is set as phase~~, in former stage of said coordinate rotation digital computation~~, a process expressed by:

when CORDICi < 0.0 and CORDICq > 0.0

CORDICi = CORDICi * -1

CORDICq = CORDICq * -1

phase = π

when CORDICi < 0.0 and CORDICq < 0.0,

CORDICi = CORDICi * -1

CORDICq = CORDICq * -1

phase = - π

is performed.

42. (Currently Amended) A frequency error predicting method employing an automatic frequency control for detecting a frequency shift of an internal oscillator of portable radio equipment with reference to a received wave transmitted from a base station and adjusting the frequency of said internal oscillator by feeding back said frequency shift to said internal oscillator, comprising of steps of:

calculating a phase difference of two symbols taken from a known data modulated by said base station on the basis of a timing generated by said internal oscillator;

calculating a frequency shift of said internal oscillator by dividing said phase difference derived by said calculating step by an interval of said two symbols; and

widening said interval when said phase difference derived by said phase difference calculating step is smaller than a predetermined set value and narrowing said interval when said phase difference is greater than said set value; and

~~A frequency error predicting method as set forth in claim 37,~~ wherein said interval controlling step sets said interval at a predetermined minimum value when out of synchronization is detected ~~at least from~~ due to one of a failure ~~of decoding~~ to decode or ~~non-detection of~~ to detect a pilot and ~~not reaching~~ a failure of power to reach a predetermined level.

43-45. (Canceled).

46. (Currently Amended) A frequency error predicting method employing an automatic frequency control for detecting a frequency shift of an internal oscillator of portable radio equipment with reference to a received wave transmitted from a base station and adjusting the frequency of said internal oscillator by feeding back said frequency shift to said internal oscillator, comprising the steps of:

calculating a phase difference of two symbols taken from a known data modulated by said base station on the basis of a timing generated by said internal oscillator;

calculating a frequency shift of said internal oscillator by dividing said phase difference derived by said calculating step by an interval of said two symbols; and

widening said interval when a value of said frequency shift derived by said frequency shift calculating step is smaller than a predetermined value and for narrowing said interval when said value of said frequency shift is greater than said predetermined value;

wherein upon calculation of arctangent of coordinate rotation digital computation, said frequency shift calculating step performs calculation within a range of $\pm\pi$; and

~~A frequency error predicting method as set forth in claim 45,~~ wherein~~, upon performing calculation of said frequency shift, in~~ said frequency shift calculating step~~,~~ further comprises deriving parameters CORDICi and CORDICq ~~are derived~~ by ~~using a calculation of~~ said coordinate rotation digital computation ~~by replacing the~~, where

a signal whose phase is to be calculated ~~the phase~~ is replaced with I and Q components, and

in calculation of said coordinate rotation digital computation, when a parameter for outputting a final angle by adding angles per taps is set as phase~~, in former stage of said coordinate rotation digital computation~~, a process expressed by:

when CORDICi < 0.0 and CORDICq > 0.0

CORDICi = CORDICq

CORDICq = CORDICi * -1.0

phase = $\pi/2$

when CORDICi < 0.0 and CORDICq < 0.0,

CORDICi = CORDICq * -1.0

CORDICq = CORDICi

phase = -(π /2)

is performed.

47. (Currently Amended) A frequency error predicting method employing an automatic frequency control for detecting a frequency shift of an internal oscillator of portable radio equipment with reference to a received wave transmitted from a base station and adjusting the frequency of said internal oscillator by feeding back said frequency shift to said internal oscillator, comprising the steps of:

calculating a phase difference of two symbols taken from a known data modulated by said base station on the basis of a timing generated by said internal oscillator;

calculating a frequency shift of said internal oscillator by dividing said phase difference derived by said calculating step by an interval of said two symbols; and

widening said interval when a value of said frequency shift derived by said frequency shift calculating step is smaller than a predetermined value and for narrowing said interval when said value of said frequency shift is greater than said predetermined value;

wherein upon calculation of arctangent of coordinate rotation digital computation, said frequency shift calculating step performs calculation within a range of $\pm\pi$; and

~~A frequency error predicting method as set forth in claim 45,~~ wherein~~, upon performing calculation of said frequency shift, in~~ said frequency shift calculating step~~,~~ further comprises deriving parameters CORDICi and CORDICq ~~are derived~~ by ~~using a calculation of~~ said coordinate rotation digital computation ~~by replacing the~~, where

a signal whose phase is to be calculated ~~the phase~~ is replaced with I and Q components of said signal, and

in calculation of said coordinate rotation digital computation, when a parameter for outputting a final angle by adding angles per taps is set as phase~~, in former stage of said coordinate rotation digital computation~~, a process expressed by:

when CORDICi < 0.0 and CORDICq > 0.0

CORDICi = CORDICi * -1

CORDICq = CORDICq * -1

phase = π

when CORDICi < 0.0 and CORDICq < 0.0,

CORDICi = CORDICi * -1

CORDICq = CORDICq * -1

phase = - π

is performed.

48. (Currently Amended) A frequency error predicting method employing an automatic frequency control for detecting a frequency shift of an internal oscillator of portable radio equipment with reference to a received wave transmitted from a base station and adjusting the frequency of said internal oscillator by feeding back said frequency shift to said internal oscillator, comprising the steps of:

calculating a phase difference of two symbols taken from a known data modulated by said base station on the basis of a timing generated by said internal oscillator;

calculating a frequency shift of said internal oscillator by dividing said phase difference derived by said calculating step by an interval of said two symbols; and

widening said interval when a value of said frequency shift derived by said frequency shift calculating step is smaller than a predetermined value and for narrowing said interval when said value of said frequency shift is greater than said predetermined value; and

~~A frequency error predicting method as set forth in claim 43,~~ wherein said interval controlling step sets said interval at a predetermined minimum value when out of synchronization is detected ~~at least from~~ due to one of a failure ~~of decoding~~ to decode or ~~non-detection of~~ to detect a pilot and ~~not reaching~~ a failure of power to reach a predetermined level.

49. (New) A portable radio system as set forth in claim 3, wherein said received wave transmitted from said base station has a higher precision of frequency than said internal oscillator.

50. (New) A portable radio system as set forth in claim 8, wherein said received wave transmitted from said base station has a higher precision of frequency than said internal oscillator.

51. (New) A portable radio system as set forth in claim 14, wherein said received wave transmitted from said base station has a higher precision of frequency than said internal oscillator.

52. (New) A portable radio equipment as set forth in claim 19, wherein said received wave transmitted from said base station has a higher precision of frequency than said internal oscillator.

53. (New) A portable radio equipment as set forth in claim 24, wherein said received wave transmitted from said base station has a higher precision of frequency than said internal oscillator.

54. (New) A portable radio equipment as set forth in claim 30, wherein said received wave transmitted from said base station has a higher precision of frequency than said internal oscillator.

55. (New) A frequency error predicting method as set forth in claim 35, wherein said received wave transmitted from said base station has a higher precision of frequency than said internal oscillator.

56. (New) A frequency error predicting method as set forth in claim 40, wherein said received wave transmitted from said base station has a higher precision of frequency than said internal oscillator.

57. (New) A frequency error predicting method as set forth in claim 46, wherein said received wave transmitted from said base station has a higher precision of frequency than said internal oscillator.

58. (New) A system or equipment employing an automatic frequency control for detecting a frequency shift of an internal oscillator of a portable radio equipment with reference to a received wave transmitted from a base station and adjusting the frequency of said internal oscillator by feeding back said frequency shift to said internal oscillator, wherein said portable radio equipment comprises;

a first circuit which calculates a phase difference of two symbols taken from a known data modulated by said base station on the basis of a timing generated by said internal oscillator;

a second circuit which calculates a frequency shift of said internal oscillator by dividing said phase difference derived by said first circuit by an interval of said two symbols; and

a third circuit which widens said interval when said phase difference derived by said calculating means is smaller than a predetermined set value, and narrows said interval when said phase difference is greater than said set value;

wherein upon calculation of arctangent by employing coordinate rotation digital computation (CORDIC), said second circuit performs calculation within a range of $\pm \pi$; and

wherein said detecting of said frequency shift comprises deriving parameters CORDICi and CORDICq by said coordinate rotation digital computation, where

a signal whose phase is to be calculated is replaced with I and Q components of said signal, and

in calculation of said coordinate rotation digital computation, when a parameter for outputting a final angle by adding angles per taps is set as phase, a process expressed by:

when CORDICi < 0.0 and CORDICq > 0.0

CORDICi = CORDICq

CORDICq = CORDICi * -1.0

phase = $\pi/2$

when CORDICi < 0.0 and CORDICq < 0.0,

CORDICi = CORDICq * -1.0

CORDICq = CORDICi

phase = -($\pi/2$)

is performed.

59. (New) A system or equipment employing an automatic frequency control for detecting a frequency shift of an internal oscillator of a portable radio equipment with reference to a received wave transmitted from a base station and adjusting the frequency of said internal

oscillator by feeding back said frequency shift to said internal oscillator, wherein said portable radio equipment comprises;

a first circuit which calculates a phase difference of two symbols taken from a known data modulated by said base station on the basis of a timing generated by said internal oscillator;

a second circuit which calculates a frequency shift of said internal oscillator by dividing said phase difference derived by said first circuit by an interval of said two symbols; and

a third circuit which widens said interval when said phase difference derived by said calculating means is smaller than a predetermined set value, and narrows said interval when said phase difference is greater than said set value;

wherein upon calculation of arctangent by employing coordinate rotation digital computation (CORDIC), said second circuit performs calculation within a range of $\pm\pi$; and

wherein said detecting of said frequency shift comprises deriving parameters CORDICi and CORDICq by said coordinate rotation digital computation, where

a signal whose phase is to be calculated is replaced with I and Q components of said signal, and

in calculation of said coordinate rotation digital computation, when a parameter for outputting a final angle by adding angles per taps is set as phase, a process expressed by:

when CORDICi < 0.0 and CORDICq > 0.0

CORDICi = CORDICi * -1

CORDICq = CORDICq * -1

phase = π

when CORDICi < 0.0 and CORDICq < 0.0,

CORDICi = CORDICi * -1

CORDICq = CORDICq * -1

phase = - π

is performed.

60. (New) A system or equipment employing an automatic frequency control for detecting a frequency shift of an internal oscillator of a portable radio equipment with reference to a received wave transmitted from a base station and adjusting the frequency of said internal oscillator by feeding back said frequency shift to said internal oscillator, wherein said portable radio equipment comprises;

a first circuit which calculates a phase difference of two symbols taken from a known data modulated by said base station on the basis of a timing generated by said internal oscillator;

a second circuit which calculates a frequency shift of said internal oscillator by dividing said phase difference derived by said first circuit by an interval of said two symbols; and

a third circuit which widens said interval when said phase difference derived by said calculating means is smaller than a predetermined set value, and narrows said interval when said phase difference is greater than said set value; and

wherein said third circuit sets said interval at a predetermined minimum value when out of synchronization is detected due to one of a failure to decode or to detect a pilot and a failure of power to reach a predetermined level.

61. (New) A system or equipment employing an automatic frequency control for detecting a frequency shift of an internal oscillator of a portable radio equipment with reference to a received wave transmitted from a base station and adjusting the frequency of said internal oscillator by feeding back said frequency shift to said internal oscillator, wherein said portable radio equipment comprises:

a first circuit which calculates a phase difference of two symbols taken from a known data modulated by said base station on the basis of a timing generated by said internal oscillator;

a third circuit which calculates a frequency shift of said internal oscillator by dividing said phase difference derived by said first circuit by an interval of said two symbols; and

a third circuit which widens said interval when a value of said frequency shift derived by said second circuit is smaller than a predetermined value, and narrows said interval when said value of said frequency shift is greater than said predetermined value;

wherein said two symbols are the same phase when a frequency of said internal oscillator is correct, and

said first circuit derives a phase difference of said two symbols by multiplying one of said two symbols by a complex conjugate of another symbol;

wherein upon calculation of arctangent of coordinate rotation digital computation (CORDIC), said second circuit performs calculation within a range of $\pm\pi$; and

wherein said detecting of said frequency shift comprises deriving parameters CORDICi and CORDICq by said coordinate rotation digital computation, where

a signal whose phase is to be calculated is replaced with I and Q components of said signal, and

in calculation of said coordinate rotation digital computation, when a parameter for outputting a final angle by adding angles per taps is set as phase, a process expressed by:

when CORDICi < 0.0 and CORDICq > 0.0

CORDICi = CORDICq

CORDICq = CORDICi * -1.0

phase = $\pi/2$

when CORDICi < 0.0 and CORDICq < 0.0,

CORDICi = CORDICq * -1.0

CORDICq = CORDICi

phase = -($\pi/2$)

is performed.

62. (New) A system or equipment employing an automatic frequency control for detecting a frequency shift of an internal oscillator of a portable radio equipment with reference to a received wave transmitted from a base station and adjusting the frequency of said internal oscillator by feeding back said frequency shift to said internal oscillator, wherein said portable radio equipment comprises:

a first circuit which calculates a phase difference of two symbols taken from a known data modulated by said base station on the basis of a timing generated by said internal oscillator;

a third circuit which calculates a frequency shift of said internal oscillator by dividing said phase difference derived by said first circuit by an interval of said two symbols; and

a third circuit which widens said interval when a value of said frequency shift derived by said second circuit is smaller than a predetermined value, and narrows said interval when said value of said frequency shift is greater than said predetermined value;

wherein said two symbols are the same phase when a frequency of said internal oscillator is correct, and

said first circuit derives a phase difference of said two symbols by multiplying one of said two symbols by a complex conjugate of another symbol;

wherein upon calculation of arctangent of coordinate rotation digital computation (CORDIC), said second circuit performs calculation within a range of $\pm\pi$; and

wherein said detection of said frequency shift comprises deriving parameters CORDICi and CORDICq by said coordinate rotation digital computation, where

a signal whose phase is to be calculated is replaced with I and Q components of said signal, and

in calculation of said coordinate rotation digital computation, when a parameter for outputting a final angle by adding angles per taps is set as phase, a process expressed by:

when CORDICi < 0.0 and CORDICq > 0.0

CORDICi = CORDICi * -1

CORDICq = CORDICq * -1

phase = π

when CORDICi < 0.0 and CORDICq < 0.0,

CORDICi = CORDICi * -1

CORDICq = CORDICq * -1

phase = - π

is performed.